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BIT WITH EXTENDED JET NOZZLES

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ABSTRACT OF THE DISCLOSURE

Performance of a three-cone, rotary drill bit may be improved by extending the jet nozzles thereof below the bit body to a level slightly above the lowermost surface of the cutter cones. The extended nozzles are reinforced and protected from bending during drilling operations by protective jackets placed between the nozzle and the borehole wall.

The invention relates to a rotary drilling bit with rotary cutting elements suitable to disintegrate rock material of underground formations, and provided with jet nozzles which are suitable to direct high velocity jets of drilling fluid to the bottom of a hole being drilled, so as to erode the hole bottom, to remove the cuttings therefrom and at the same time to clean and cool the cutting elements. These nozzles are preferably made of a wear-resisting material since the driling fluid flowing therethrough usually has abrasive properties. In particular, the present invention relates to a rotary drilling bit of the above construction, in which the jet nozzles are of the so-called extended type. Whereas the jet nozzles of the normal type are mounted directly in the bit body, the extended type nozzles are carried at the lower end of tubular elements extending in a downward direction from the bit body and communicating with the interior thereof. Each tubular element protrudes between a pair of adjacent rotary cutting elements.

In view of the fact that the distance existing between the discharge opening of each jet nozzle and the bottom of the hole is smaller in the case of extended jet nozzles than the case of nozzles directly mounted in the bit body, the fluid velocity over the hole bottom of the jet streams issuing from the jet nozzles is remarkably greater when using extended nozzles than when using nozzles which are directly mounted in the bit body. The resulting greater fluid velocity along the hole bottom results, as has been found in tests carried out in the laboratory as well as in the field, in a higher penetration rate of the drilling bit during the drilling process carried out thereby.

Unfortunately, it has been found in the field tests with rotary drilling bits having extended jet nozzles, that the extended nozzles are very liable to damage, especially by engagement of foreign objects with the lower ends thereof. Such damage often causes displacement of the lower ends of the tubular elements carrying the nozzles, which is to be considered absolutely undesirable since as a result of the small distance existing between the outer wall of each tubular element and the adjacent cutting elements, the damage of the tubular elements will even become greater when these elements are forced against the rotating cutting elements. Moreover such displacement may even prevent the cutting elements from rotating, resulting in skidding of the cutting elements and premature wear of some of the teeth carried thereby.

Strengthening the lower ends of the tubular elements might be a solution for preventing excessive damage thereof. However, due to lack of space, such strengthening is not feasible in view of the limited areas available between each pair of adjacent rotary cutting elements,

through which areas the tubular elements have to pass.

Another solution would be to use extended jet nozzles of shorter length, which nozzles would have their lower ends at a level relative to the rotary cutting elements where a sufficient space is available for allowing the use of the required reinforcements. This solution would, however, decrease the drilling penetration rate since the distance between the discharge of each nozzle and the borehole bottom would have been increased which would unfavorably affect the interaction of the bit teeth and the hole bottom.

The present invention now provides a solution for the existing problem, whereby damaging of the lower ends of the extended jet nozzles is prevented without influencing the drilling penetration rate.

A rotary drilling bit according to the invention comprises a bit body, legs extending from said body in a downward direction, bearing members on said legs, rotary cutting elements rotatably carried by the bearing members, tubular elements carried by the body, each tubular element communicating at one end thereof with the interior of the bit body and carrying at the other end thereof a nozzle, and protruding in a downward direction between a pair of adjacent cutting elements, each tubular element being provided, except at the lower end thereof, with a wear-resisting cover protecting at least that part of the tubular element facing the exterior of the drilling bit.

The tubular element may be a pipe or tube. In another embodiment, the tubular element may be a body through which a channel passes.

The wear-resisting cover may have a U-shaped horizontal cross-section and may, in one embodiment, be separate from the tubular element. In another embodiment, the cover may be formed by a layer of wear-resisting material which is bonded to the outer surface of the tubular element.

The radius of the outer wall of each cover is at most equal to the radius of the outermost parts of the cutting elements, and preferably the difference between these radii is at most ⅛ inch.

The radius of the outer wall of each cover is preferably at least 1/16 inch greater than the radius of the outermost parts of the lower ends of the tubular elements.

The invention will be further described with reference to the drawings in which:

FIGURE 1 shows by way of example a perspective view of a rotary drilling bit according to the invention with a sector cut away so as to show one of the extended nozzles in longitudinal section;

FIGURE 2 shows (on a scale smaller than FIGURE 1) schematically a cross-section taken over line 2—2 in FIG. 1, indicating at which part of the drilling bit the sector has been cut away, as well as the direction (arrow I) in which the view shown in FIG. 1 has been taken; and

FIGURES 3–6 are cross-sections of conduit tubes provided with protection covers of four different constructions, all according to the invention.

The rotary drilling bit as shown in the drawing comprises a bit body 1 which is provided at the upper side thereof wtih a hollow shank 2, in the outer wall of which is formed a screw thread 3. The interior 4 of the bit body 1 communicates with a conduit 5 formed within the shank 2.

Three legs 6 (only two of which appear in FIG. 1) form part of the bit body 1 and extend in a downward direction. In a manner known per se (and not shown in the drawing) each leg 6 is provided with bearing means for rotatably supporting a conical cutting element 7, which element is provided with teeth or other cutting